

Hybrid Power Systems for Russia's Northern Territories

by C. Dennis Barley and Vahan Gevorgian 12/99

Background

In the northern areas of Russia (including the Kola Peninsula, the Arkhangelsk region, the Chukotka Peninsula, and other locations), a number of lighthouses, small industrial villages, and meteorological station facilities receive electric power from one of two sources. An existing grid serves a portion of the area and small, local diesel power plants serve the remaining locations. In some cases, the reliability of the grid service is deemed unacceptable and local independent power stations are needed. As for the small diesel plants, diesel fuel prices in northern Russia range from about \$0.36/liter to \$1.30/liter, and the demand for electricity often exceeds available fuel supplies.

These conventional power issues are helping to open up a market for renewable energy sources. The wind resource in northern Russia is very good, particularly in the Murmansk and Arkhangelsk regions. The estimates of the annual average wind speed for those regions range from 7 to 9.5 m/s for the coastal areas and from 4 to 7 m/s inland. Most of the territories lie near or north of the Arctic Circle, so icy conditions and permafrost ground are concerns.

Scope

The United States Agency for International Development (USAID) has provided \$1.4 million for the purchase of 40 Bergey Windpower Company, Inc., wind turbines [10 rated at 1.5 kilowatts (kW) and 30 rated at 10 kW], batteries, solid-state power converters, and other equipment for retrofitting existing diesel plants with hybrid systems. Candidate project sites were selected on the basis of the infrastructure necessary to maintain the systems, the wind resource at the site, the fuel price and availability at the site, and a variety of applications to serve as pilot projects. The U.S. team provided system designs, equipment, and training of local technicians in installation and maintenance.

Status

Based on a preliminary assessment of loads, wind speeds, and fuel prices, analysis at the National Renewable Energy Laboratory (NREL) indicated that optimal cost-effective hybrid retrofits for roughly six villages and ten smaller projects could be fashioned from the set of equipment provided by USAID funds. During the summer of 1997, two Russian engineers spent two months with the NREL team using the *Hybrid2* simulation model to analyze hybrid systems for northern Russia. Upon their return to Russia, they became key members of a Russian team that consists of specialists representing the Russian Ministry of Fuels and Energy, the Federal Center of Small and Nontraditional Energy, and the Intersolarcenter.

Two hybrid systems, both in the Arkhangelsk region (two 10-kW turbines at Krasnoe village and one 10-kW turbine at Bolshie Kozli village), were installed in 1997. Two more 10-kW turbines were installed in the Arkhangelsk region at Megra village in 1999. Eight 1.5-kW turbines were installed in Chukotka and two 10-kW were installed in Sosnovka village in the Murmansk region. In addition, the Russians installed one 1.5-kW wind turbine at the wind-diesel demonstration site in Istra, near Moscow. This site is equipped with U.S. and Russian-made monitoring equipment and serves as a training center for Russian engineers and technicians involved in the deployment and operation of wind-diesel systems in Russia. The performance monitoring system provided by NREL was also installed on the hybrid system in Krasnoe village (Arkhangelsk region) in 1998.

The Bergey team provided a two-week installation and operations and maintenance training seminar for local engineers and technicians in October and November of 1997. Planned activities for the project team and partners include continuing to gather information, perform analysis and system design, and install and monitor systems.

Team/Partners

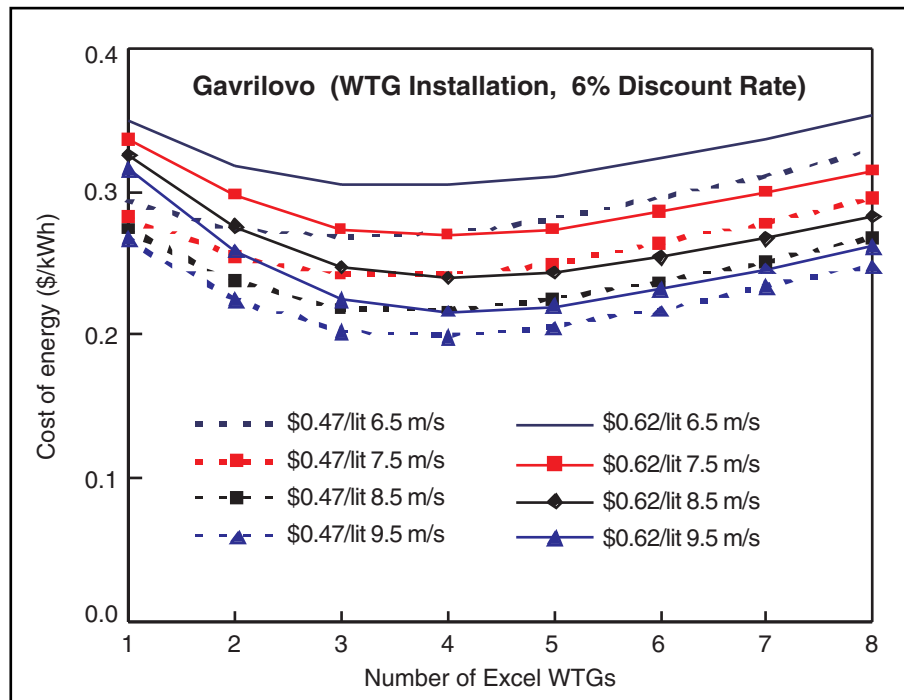
- Russian Ministry of Fuels and Energy
- Intersolarcenter
- Federal Center of Small and Non-traditional Energy
- Darup Associates

NREL Contacts

Web site: <http://www.rsvp.nrel.gov>

Ken Touryan
phone: 303-275-3009
fax: 303-275-3040
e-mail: ken_touryan@nrel.gov

Larry Flowers
phone: 303-384-6910
fax: 303-384-7097
e-mail: lawrence_flowers@nrel.gov



This graph illustrates a study of the least-cost sizing of a wind turbine array for a sample small village, based on preliminary data and analysis, with fuel price and wind speed as parameters. Similar studies were conducted for a number of villages and meteorological stations.

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